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Research Report No. 4

JUNGLE VISION IV:

An Exploratory Study on the Use of

Yellow Lenses to Aid Personnel Detection in

an Evergreen Rainforest.

by

D. A. Dobbins, M. Gast, and C. M. Kindick

July 1965

DA Project 1L013001A91A 00 001
(An In-House Laboratory Independent Research Project)

US ARMY
TROPIC TEST CENTER
Fort Clayton, Canal Zone

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ABSTRACT

The purpose of this study was to explore the use of nonmagnifying yellow lenses to enhance personnel detection in the evergreen rainforest. Twelve US Infantry soldiers with normal vision, using spectacles fitted with yellow lenses, were each presented 45 randomly appearing human targets within a 180° field of search. The targets, who were dressed in standard Army field clothes, stood motionless at predetermined distance markers facing the observer. Tests were conducted on three sites in the evergreen rainforest of the Canal Zone during the dry season (April 1965). Results were compared with those obtained from 18 additional observers with unaided vision, who were tested on the same sites and under the same conditions.

The major effect of using the yellow lenses was to restrict rather than increase detectability of human targets. Perceptually, the lenses made the targets appear farther from the observers, resulting in significant distance overestimation. Detection times and practice effects were not affected by use of the lenses.

FOREWORD

This is the fourth report in the Tropic Test Center series dealing with personnel detection in tropical forests. The research is supported by the US Army In-House Laboratory Independent Research Program.

The primary purpose of these studies is to provide a baseline of quantitatively sound data concerning the visual capabilities of the soldier in the jungle. From the standpoint of the Test and Evaluation mission of the Center, these data afford measures for use in evaluating the results of tests involving various types of visual aids. Moreover, the techniques used for measuring visual thresholds in the field are also applicable for testing equipment designed to enhance visual capabilities. In fact, the present study departs from the preceding three by evaluating the feasibility of a commercial visual aid for jungle use.

The Tropic Test Center, because of its geographic location, is ideally situated to collect these basic data and thus help close the gap in our present knowledge.

Beyond the Test and Evaluation mission, however, these reports may have implications for tactics, training, and operations. For these reasons, the reports are given wide distribution.

The authors gratefully acknowledge the technical advice and free materials furnished by Bausch & Lomb, Inc.1/, to make this study possible.

1/ Reference to a corporate entity in this report is for information only and does not constitute an official indorsement or approval of the entity or its products.

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BRIEF OF RESULTS

The purpose of the study was to explore the possibility that yellow lenses would increase personnel detection in the evergreen rainforest. These lenses are designed to filter out portions of the blue-green spectrum and thus enhance apparent brightness and contrast in low illumination environments. The lenses are used commercially for inspection and sporting purposes.

Twelve US Infantry observers with normal vision, using spectacles fitted with yellow lenses, were each presented 45 randomly appearing human targets within a 180° field of search. The targets, who were dressed in standard Army field clothes, stood motionless on predetermined distance markers facing the observer. Testing was conducted on three sites in the evergreen rainforest during the dry season. Test results from the 12 observers using lenses were compared with test results from 18 additional observers with unaided vision. The latter group--used as controls for this study-- was tested on the same jungle sites under identical conditions. The results of the comparisons are as follows:

1. Yellow lenses significantly degraded average target detections as measured by the 50% visual threshold of individual observers. The average threshold for the unaided vision group exceeded the average threshold for the lens group by about 10 feet.

2. The unaided vision group exceeded the yellow lens group in percentage of target detections by about seven percent. The difference was not statistically reliable. There was no tendency for either group to differ greatly at either the closest or the more distant targets in terms of overall percent detections.

3. Perceptually, targets viewed through the lenses appeared to be farther from the observer. Observers using yellow lenses overestimated true target distances to a significantly greater extent than did observers with unaided vision.

4. There was no difference between the yellow lens and unaided vision groups with respect to the time required to make target detections nor was there evidence of practice effects for either group.

5. Threshold variability from observer to observer was significantly higher for the unaided vision group. This finding, however, may be the result of a statistical rather than an optical effect.

6. Performance differences between the yellow lens and unaided vision groups could not be attributed to ambient illumination differences at the test sites.

It is concluded that the use of nonmagnifying yellow lenses with approximately 50% transmission at 510 millimicrons to enhance personnel detection in the evergreen rainforest is unwarranted under the present experimental conditions. It should be pointed out that the study did not attempt to investigate other important aspects of personnel detection such as moving targets, observing from highly vegetated areas outward into brighter target areas, and vertical search fields. It should be further noted that ambient illumination was two to three times higher than wet season levels measured at the same sites.

INTRODUCTION

Little quantitative data are available on visual thresholds in tropical forests. The US Army Tropic Test Center has initiated a series of studies to establish normative visibility data under a variety of environmental conditions to provide this information.

The present report is the fourth of this series; it differs from past studies by exploring the feasibility of enhancing target detectability in the evergreen rainforest by the use of nonmagnifying yellow lenses designed for low illumination environments. In the preceding three studies, vision was unaided.

BACKGROUND

In the Tropic Test Center's first study, Jungle Vision I 1/, visual thresholds were established for a semideciduous tropical forest during the dry season. In the second study, Jungle Vision II 2/, visual thresholds were investigated in an evergreen rainforest during the wet season. In the third study, Jungle Vision III 3/, the effect of seasonal variation on target detectability in an evergreen rainforest was investigated.

In the present study, data collection took place concurrently with the Jungle Vision III data collection. A total of 30 observers 4/ were tested for both studies--18 unaided, and 12 equipped with special lenses. Results obtained from the 18 unaided observers were used as control data in the present study.

1/ Dobbins, D. A., and M. Gast. Jungle Vision I: Effects of distance, horizontal placement, and site on personnel detection in a semideciduous tropical forest, US Army Tropic Test Center Rep, Fort Clayton, Canal Zone, Apr 1964.

2/ Dobbins, D. A., and M. Gast. Jungle Vision II: Effects of distance, horizontal placement, and site on personnel detection in an evergreen rainforest, US Army Tropic Test Center Rep, Fort Clayton, Canal Zone, Nov 1964.

3/ Dobbins, D. A., M. Gast, and C. M. Kindick. Jungle Vision III: Effects of seasonal variation on personnel detection in an evergreen rainforest, US Army Tropic Test Center Rsch Rep #3, Fort Clayton, Canal Zone, May 1965.

4/ All observers were provided by the Commanding Officer, 4th Battalion, 10th Infantry, through the assistance of the Chief, Combat Developments Office, US Army Forces Southern Command.

This exploratory investigation was an outgrowth of Jungle Vision II, in which ambient illumination was found to average only 10 to 20 foot-candles in a wet season evergreen rainforest. Utilizing the consultative services offered by Bausch & Lomb, Inc., 1/ the senior author requested advice on the feasibility of enhancing target detectability through the use of colored lenses--particularly those designed for low illumination environments. The rationale for this request was that those lenses inhibiting transmission of the shorter wavelengths (blues and greens) of the visible spectrum might enhance contrast and apparent brightness enough to have a significant influence on target detection in the overwhelmingly green surroundings of the rainforest. The author's initial interest in this potential application of optics was stimulated by an informal communication. 2/

The reply confirmed the potential usefulness of these lenses. The reply also suggested the feasibility of using didymium filters to enhance contrast effects in higher illumination environments.

In addition to furnishing advice, Bausch & Lomb, Inc., 1/ furnished the Tropic Test Center, at no cost, one each of the following nonmagnifying items:

a. Light yellow lenses fitted in chemical goggles with 50% transmission at 460 millimicrons.

b. Yellow lenses fitted in spectacles with 50% transmission at 510 millimicrons.

c. Yellow-orange lenses fitted in spectacles with 50% transmission at 540 millimicrons.

d. Light red lenses fitted in spectacles with 50% transmission at 580 millimicrons.

e. Dichroic lenses fitted in spectacles with a sharp cutoff followed by a sharp rise in the middle (yellow-orange) portion of the spectrum. This item was designed to enhance contrast effects.

The above listed items, with the exception of the dichroic lenses, systematically filter out an increasingly greater proportion of the blue-green spectrum, and thus result in greater apparent brightness of oranges and reds. The yellow-hued lenses are used extensively by hunters and marksmen to aid in detection and tracking of targets.

1/ Reference to a corporate entity in this report is for information only and does not constitute an official indorsement or approval of the entity or its products.

2/ Mayer, Harris L. Personal communication, 16 November 1964.

The 12 observers used in the present study were equipped only with the yellow lenses (item b, page 4) with 50% transmission at 510 millimicrons 1/. The other lenses will be evaluated in future studies.

METHOD

Observers. Two groups of observers (Os) were tested. Twelve Os were tested with glasses. Eighteen Os were tested with unaided vision. All Os were pretested to ensure normal near, far, and color vision, as well as normal depth perception. Comparison of the two groups is shown below.

	Os with Lenses (N=12)	Os with Unaided Vision (N=18)
Average age:	24.5 years	22.2 years
Age range:	19-33 years	19-28 years
Average length of service:	52.2 months	32.7 months
Range of grades:	E3 to E5	E2 to E5
No. EM in Combat MOS:	10 of 12	All 18

Targets. Targets were US Army soldiers dressed in standard military utility (fatigue OG-107) uniform without insignia, including jacket, cap, bloused trousers, and jungle boots. The targets had their faces blackened with charcoal.

Experimenters. Two experimenters (Es) controlled the testing, which was done concurrently at two sites per day. The Es followed identical standardized procedures during all aspects of testing.

Independent Variables. Three independent variables were investigated: yellow lenses vs. unaided vision, target distance (40 to 115 feet), and horizontal target placement (five radii) in O's field of search (180°).

Dependent Variables. Three performance measures were used. The first measure was the 50% detection threshold--that distance at which a target is detected 50% of the time. The second measure was distance estimation of detected targets. The third measure was detection time--the amount of search time required to detect a target.

Sites. Three identical test grids were laid out in the relatively mature evergreen rainforest of Fort Sherman in the Canal Zone (see Fig. 1).

1/An initial attempt was made to use item a. (in chemical goggles) but was discontinued because the high humidity and poor air circulation caused the lenses to fog after being worn for only a few minutes. Subsequently, a chemical applicant was obtained that prevents fogging.

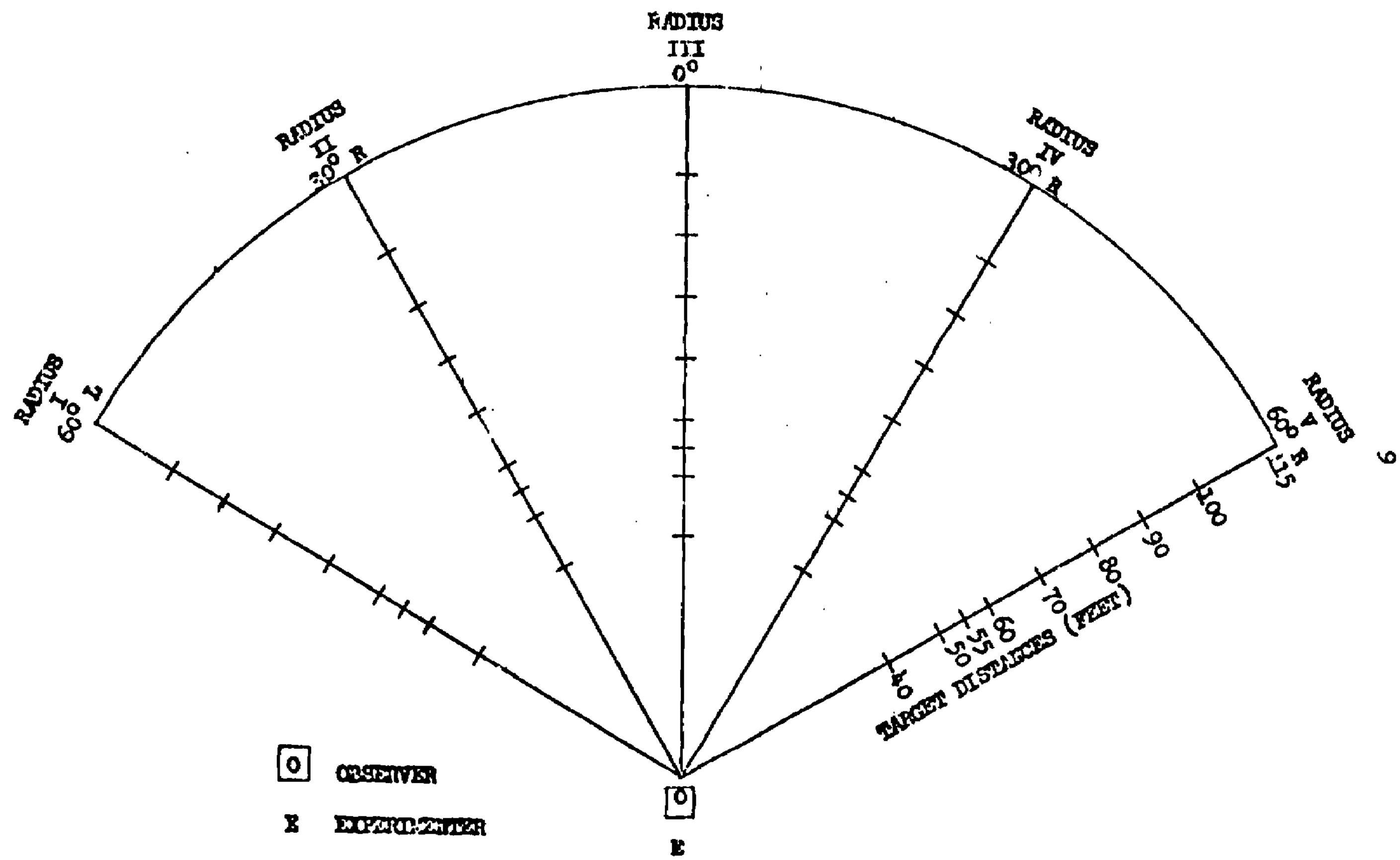

FIGURE 1. SKETCH OF TEST SITE SHOWING TARGET DISTANCES AND PLACEMENT.

The sites were selected on the basis of representativeness of vegetation and flatness of terrain. For photographs and description of sites, the reader is referred to the Jungle Vision II and III reports. The study was conducted toward the end of a severe dry season.

Research Design. The research design is summarized in Table I. Three subgroups of four Os each, comparable in visual acuity, were assigned randomly to each of the three sites and tested with the yellow lenses. Observers, both those equipped with yellow lenses and the unaided vision group, were each presented 45 targets which appeared randomly with respect to target distance and horizontal placement (radii). Each O was presented nine targets per radius, for a total of 540 observations for Os with lenses and a total of 810 observations for the unaided vision group. Observers with lenses were administered the identical tests on the same sites as the control group; the only difference was the use of glasses.

TABLE I

Research Design of Jungle Vision IV

		Yellow Lenses					
		Radius					
Site	Number Observers	I	II	III	IV	V	Total (n)
		Number Observations (n)					
X	N= 4	36	36	36	36	36	180
Y	N= 4	36	36	36	36	36	180
Z	N= 4	36	36	36	36	36	180
Total	N=12	108	108	108	108	108	540
		Unaided Vision					
X	N= 6	54	54	54	54	54	270
Y	N= 6	54	54	54	54	54	270
Z	N= 6	54	54	54	54	54	270
Total	N=18	162	162	162	162	162	810
Grand Total	N=30	270	270	270	270	270	1350

Procedure. Illumination measures were taken at all Os' eye levels and at the midpoint of each radius with a GE type 213 light meter 1/ before and after testing. All sites were laid out approximately north-south to minimize the effect of sunlight on O's vision. Four Os were tested, one at a time, each morning by two field teams. The Os not being tested were not allowed to see tests in progress. The O was informed by E, reading from a standardized set of instructions, that this was a test of his ability to spot targets in a jungle environment. The O was informed that targets would appear at any point from nine o'clock to three o'clock (180°). The O was informed that he had two minutes to make a detection; if at the end of that time he had not detected a target, a nondetection was scored. The O was fitted with ear protectors to reduce the possibility of responding to auditory cues caused by movements of the targets through the vegetation. The O was urged to guess when he was unsure of the location of the target. (See detailed instructions to Os in Appendix C.)

Before the appearance of the first target, E turned O around facing away from the course. E signalled one target into the first position. The target took his place on a given radius at a preemplaced distance marker and stood immobile, facing the O. The target returned a whistle signal informing E that he was in position.

The O was confined to a marked three-feet square. He was allowed to bend, twist, crouch, or lie down while searching for the targets but was not allowed to move his head outside the marked square. The O was required to point and give a distance estimate when he detected a target, but the O was not informed as to the correctness of his detection. After the first trial, E again turned the O around and signalled a target for the next position. The above sequence was repeated until O completed 45 observations. Total testing time for one O averaged one and one-half hours. One rest pause of five minutes was allowed after the 23rd observation.

RESULTS

Detection Thresholds. Table II compares the 50% detection thresholds for the unaided vision group and the yellow lens group. On each site, detectability was higher without the lenses. Overall, the unaided threshold was 10 feet higher than the lens threshold. When the average 50% threshold of the 18 Os with unaided vision was compared with the average 50% thresholds of the 12 Os equipped with lenses by means of t-test, it was found that the lenses significantly degraded 50% target detectability ($t=2.21$; $df=28$; $P<5\%$). One could question the practical significance of this finding on the basis of the low absolute difference of 10 feet; however, 10 feet represents approximately 10% of the available visual envelope in this type vegetation (see Jungle Vision III).

1/ Reference to any trade name used in this report does not constitute an official indorsement or approval of the use of said item.

TABLE II

50% detection thresholds with and without lenses at each of three evergreen rainforest sites.

Site	Unaided Vision (feet)	Yellow Lenses (feet)
X	74.0	57.2
Y	71.1	66.0
Z	75.0	70.0
All sites	73.9	63.7

Effects of Target Distance. Table III compares the percent of detections for each of the nine target distances for the unaided vision group and the yellow lens group. Of the 27 possible paired comparisons within sites, 20 showed higher percent detections for the unaided vision group.

TABLE III

Percent of targets detected with and without lenses at each of nine distances at three evergreen rainforest sites (dry season).

	Site							
	X %		Y %		Z %		All sites	
Distance (feet)	Unaided Vision	Yellow Lenses	Unaided Vision	Yellow Lenses	Unaided Vision	Yellow Lenses	Unaided Vision	Yellow Lenses
40	93.3	90.0	80.0	85.0	96.7	85.0	90.0	86.7
50	90.0	70.0	80.0	75.0	83.3	80.0	84.4	75.0
55	86.6	80.0	73.3	75.0	86.7	65.0	82.2	73.3
60	63.3	35.0	66.7	65.0	60.0	65.0	63.3	55.0
70	66.7	35.0	53.3	40.0	60.0	50.0	60.0	41.7
80	40.0	25.0	23.3	20.0	40.0	30.0	34.4	25.0
90	26.7	35.0	20.0	15.0	36.7	30.0	27.8	26.7
100	13.3	0.0	16.7	10.0	13.3	5.0	14.4	5.0
115	0.0	0.0	0.0	0.0	10.0	25.0	3.3	8.3
All Distances	53.3	41.1	45.9	42.7	54.0	48.3	51.1	44.0

When the percentage of detections 1/ on a distance-by-distance basis was subjected to an analysis of variance, the difference between the percentages of detections for all sites with yellow lenses (44.0%) and unaided vision (51.1%) was not significant ($F=3.12$; $df=1/4$; $P > 10\%$). There is no conflict between this finding and that reported in the preceding paragraph. The previous analysis compared 50% threshold data between individual Os in the two groups; the present analysis compared overall percent detections, combined for all distances and all observers. Thus, it is concluded that there was no significant superiority to either the unaided vision or yellow lens groups with respect to total percent detections.

Distance, as a source of variance, was highly significant ($F=64.78$; $df=8/32$; $P < 0.1\%$). This is a statistical confirmation of the obvious fact that distance drastically affected target detectability for both groups.

More important was the test of the interaction between mode of detection (glasses vs. unaided vision) and target distance. The interaction was not statistically significant ($F=0.76$; $df=8/32$; $P > 20\%$). These results indicate that there were no significant differences in percent detections among the two groups from one target distance to another. Further verification of this fact can better be seen in Figure 2. The conformations--or slopes--of the two functions were very similar. This ~~similarity confirms~~ the nonsignificant interaction.

Distance Estimation. Table IV compares the results of 16 Os with unaided vision and 11 Os with yellow lenses in estimation of distances to detected targets. Results are shown for only those Os who used the Metric system in their estimates. (Data for three Os using the English system for estimating were eliminated because results of past studies have shown that the particular estimating system employed causes more bias in estimated distances than environmental variables.) When compared by t-test, it was found that those Os using the yellow lenses overestimated all target distances to a significantly greater extent than those Os with unaided vision ($t=2.19$; $df=25$; $P < 5\%$).

Detection Time. Time required to detect targets is compared between the two groups in Table V. The grand mean detection time averaged for all sites and distances was 28.6 seconds for the group with the unaided vision and 35.6 seconds for the group with yellow lenses. When these means were subjected to t-tests, however, the difference proved statistically insignificant ($t=1.38$; $df=12$; $P > 10\%$). Thus, for those detections which were made, there was no significant superiority in the search time necessary for either the Os with unaided vision or the Os using yellow lenses.

1/ Percent detection subjected to inverse sine transformation prior to analysis of variance.

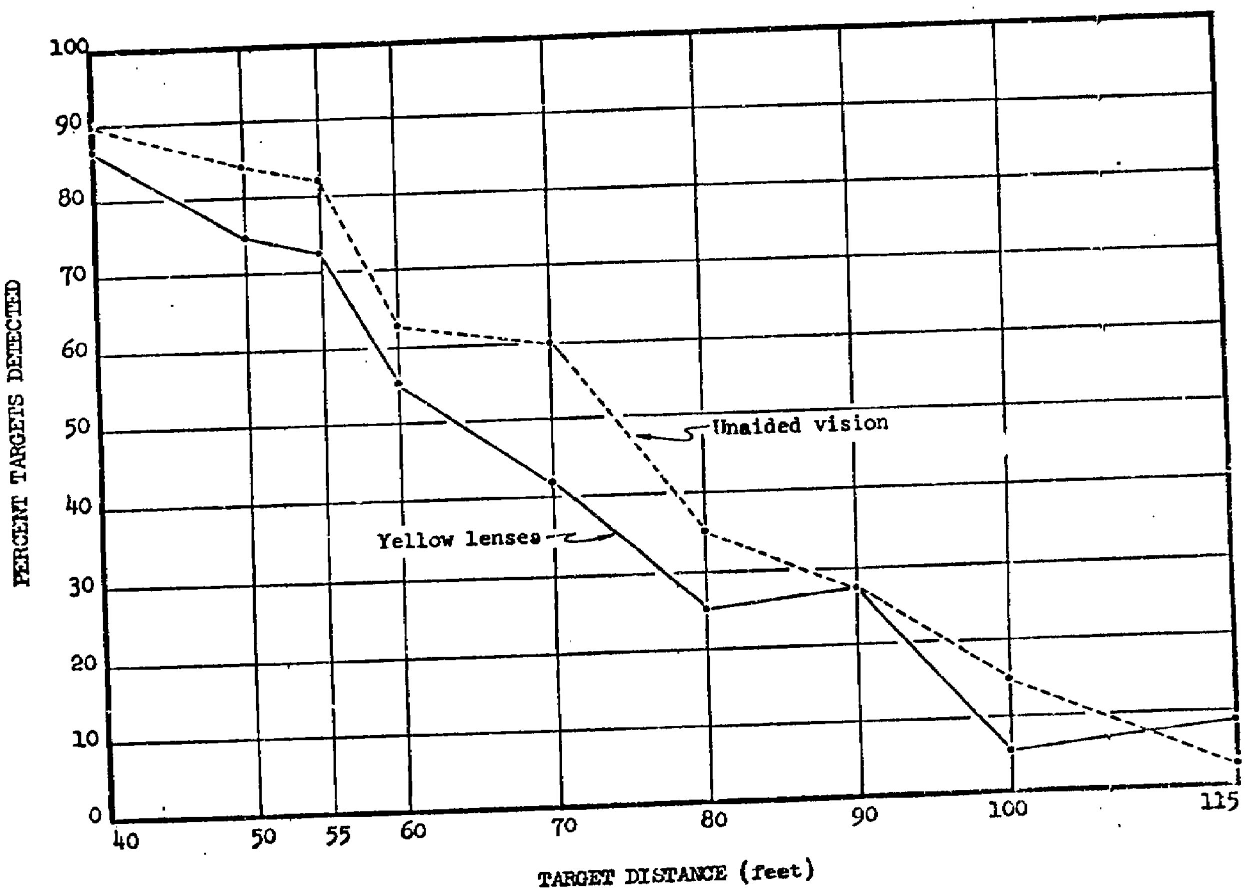

FIGURE 2. COMPARISON OF TARGET DETECTABILITY WITH UNAIDED VISION AND WITH SPECIAL LENSES IN AN EVERGREEN RAINFOREST (DRY SEASON)

TABLE IV

Actual target distances and observer estimates made with unaided vision and with yellow lenses (dry season).

Actual Distance (feet)	Estimated Distance (Median) (feet)			Number of Estimates	
	Unaided Vision (U)	Yellow Lenses (L)	Difference (L)-(U)	Unaided Vision	Yellow Lenses
40	34.5	47.4	+12.9	71	52
50	48.0	58.9	+10.9	67	45
55	47.8	75.5	+27.7	65	44
60	62.1	73.0	+10.9	50	33
70	76.5	106.5	+30.0	46	25
80	94.0	163.5	+69.5	27	15
90	93.0	123.0	+30.0	22	16
100	*	*	---	13	3
115	*	*	---	3	5

* Insufficient cases for reliable comparisons.

TABLE V

Time in seconds for target detection for observers with yellow lenses and observers with unaided vision (dry season).

	TARGET DISTANCE (feet)								
	40	50	55	60	70	80	90	100	115
Unaided Vision	15.9 (81)	25.0 (76)	26.2 (74)	27.1 (57)	29.6 (54)	43.2 (31)	33.2 (25)	*	*
Yellow Lenses	29.4 (52)	21.9 (45)	32.8 (44)	31.4 (33)	34.8 (25)	44.6 (15)	55.9 (16)	*	*

* Insufficient basis for reliable comparison.

( ) Number detections per distance.

Ambient Illumination. Measures of illumination were taken immediately before and after each O was tested. Readings were taken at Os' eye levels and on the 50-feet marker on each of the five radii. Table VI shows the results for the two observer groups. When subjected to t-tests, it was found that there was no significant difference between the average illumination for the two groups for either those tested at early morning (t=0.38; df=12; P>60%), or for those tested at midmorning (t=0.40; df=14; P>60%). Thus, any differences in target detection performance between the unaided vision and the lens groups cannot be attributed to differences in illumination.

TABLE VI

Average illumination in foot-candles taken on test sites (dry season).

(a) Eye Level of Observer

	Site					
	X	N	Y	N	Z	N*
Unaided Vision	21.1	9	20.7	9	58.8	9
Yellow Lenses	16.7	4	18.1	4	40.2	4

(b) 50-feet markers on radii

	X	N	Y	N	Z	N*
Unaided Vision	16.2	45	42.3	45	37.3	45
Yellow Lenses	15.5	20	33.8	20	41.3	20

* N refers to number of illumination measures taken.

Threshold Variability of Individual Observers. Table VII shows detection thresholds for individual observers along with means and standard deviations. Sites are disregarded in the table since all three sites are represented proportionately in each of the two arrays of thresholds. The means were subjected to a t-test previously in the report (see "Detection Thresholds" section) and found to significantly favor the unaided vision group. The focus of interest in Table VII is the variation in thresholds between the two groups. A comparison of the standard deviations shows that the thresholds of Os using yellow lenses fluctuated less from O to O than did Os with unaided vision. Comparing these variances by means of F-test indicates that individual threshold variability of Os with unaided vision significantly exceeded the variability of Os with glasses (F=3.04; df=17/11; P<5%). The extent to which this effect can be attributed solely to the use of glasses is questionable. A statistical condition may be responsible since smaller samples are likely to have smaller standard deviations than larger samples drawn from the same distribution. This effect occurs because extremes are less likely to appear in small samples. Because 18 Os contributed to the standard deviation of the unaided group, but only 12 Os contributed to the lens group, the significant difference may be due to the effect of the glasses, differences in sample size, or some combination of these two factors.

TABLE VII

Means and standard deviations of detection thresholds for observers with unaided vision and with yellow lenses.

	Unaided Vision	Yellow Lenses
	77.5	56.2
	77.5	59.1
	85.0	58.7
	72.6*	69.8*
	65.0	72.5
	72.5	65.0
	78.4	62.5
	75.0	67.5
	57.5	70.1*
	72.5	72.5
	58.7	77.5*
	67.5	67.5
	95.0	
	77.5	
	73.4*	
	62.5	
	78.5*	
	71.1*	
Mean =	73.2	66.5
σ =	8.8	5.0
N =	18	12

* Thresholds estimated by least squares.

Practice Effects. Table VIII compares practice effects between the two groups. The purpose of this comparison was to determine whether the relatively poorer performance demonstrated by Os wearing glasses could be attributed to "getting used" to the glasses during the earlier trials and thereby depressing their overall threshold scores. The average number of detections during successive five-block trials was thus computed for both groups. The results show that there was no systematic improvement in performance for either group when task difficulty (mean actual distance) is considered. Thus, the poorer performance showed by the lens group cannot be attributed to habituation.

TABLE VIII

A comparison of practice effects between observers with unaided vision and yellow lenses.

Block of Five Trials	Mean Number Detections		Mean Actual Distance (feet)
	Unaided Vision	Yellow Lenses	
1st	2.3	2.1	66
2nd	1.6	1.5	78
3rd	3.3	2.7	64
4th	1.8	1.7	84
5th	2.1	1.8	71
6th	2.7	1.8	80
7th	3.6	2.9	64
8th	2.6	2.3	72
9th	2.6	2.6	81

SUMMARY OF RESULTS

The major effect of wearing yellow lenses was to restrict rather than increase detectability of human targets. Perceptually, targets appeared farther from the observers wearing the lenses, resulting in significant distance overestimation. It may be that the glasses also restrict the range of observer threshold differences; however, this finding is ~~tenuous.~~ Detection times and practice effects were not affected by use of the glasses.

CONCLUSIONS

The use of nonmagnifying yellow lenses with 50% transmission at 510 millimicrons to enhance personnel detection in an evergreen rainforest is not warranted. This conclusion applies only under the specific experimental conditions of the present study, which included: fixed observer position; motionless, standing, human targets; low target-background contrast; and horizontal field of search. It should further be noted that the study was made during the dry season, when ambient illumination levels were from two the three times higher than wet season levels on the same sites.

(NOT USED)

Dr. McPhit -

Addressees No. of C

Commanding Officer
US Army Tropic Test Center
P. O. Drawer 942
Fort Clayton, Canal Zone
ATTN: Major Straight
US Air Forces Scientific Technical
Liaison Officer 4

(NOT USED)

APPENDIX A

ORDER OF TARGET PRESENTATION*

Distance (feet)	Radius				
	I	II	III	IV	V
40	15	10	19	5	31
50	34	14	3	40	21
55	39	43	45	9	36
60	28	32	11	25	24
70	17	13	30	27	1
80	8	23	35	4	18
90	2	38	41	33	44
100	26	12	29	22	7
115	37	6	42	16	20

* Sequence followed for unaided vision and yellow lens group

(NOT USED)

APPENDIX B

Sequence of observers tested showing the unaided vision and the yellow lenses by site and by test day.

Mode of Detection*	Site	Test Day
UV	X	1
UV	X	1
UV	Y	1
UV	Y	1
YL	X	2
UV	X	2
UV	Z	2
UV	Z	2
UV	Y	3
UV	Y	3
UV	Z	3
UV	Z	3
UV	X	4
UV	X	4
YL	Y	4
YL	Y	4
YL	X	5
YL	X	5
UV	Y	5
UV	Y	5
YL	Y	6
YL	Y	6
UV	Z	6
UV	Z	6
UV	X	7
YL	X	7
YL	Z	7
YL	Z	7
YL	Z	8
YL	Z	8

* Note: UV - Unaided Vision
YL - Yellow Lenses

(NOT USED)

APPENDIX C

Instructions given to Os by E prior to the start of each test session.

"We are trying to find out how well you can detect targets through the foliage. (In this particular test, we want to find out if these glasses assist you in detecting targets.)* You will see one of these fellows (demonstrate) standing up facing you between nine o'clock (point) and three o'clock (point) at different distances from you. There will be only one target at a time. When I give you the signal, you are to stand up in this marked box (point) and search for the target. You may crouch, kneel, or even lie down, providing you don't move your head out of the box (demonstrate). If you spot him, point in his direction and tell me how far away you think he is. You will have two minutes to find him. If you don't spot him in the time limit, I will turn you around and score a miss. If you think you see him, but are doubtful, go ahead and guess. There will be 45 trials in all, and the test will last about an hour and a half. Are there any questions?"

* Read only to the yellow lens group.

(NOT USED)

APPENDIX D

Definitions of Statistical Symbols

F-ratio:	This ratio is derived from the analysis of variance. The analysis of variance yields the probability that the variation in a set of means may be attributed to random sampling from a common, normally distributed population.
Probability (P):	This symbol refers to the level of confidence which may be placed in the statistical significance of values derived from many different types of statistical tests and measures.
Degrees of freedom (df):	Degrees of freedom are related to the number of observations entering into a particular test of significance. To some extent, the degrees of freedom determine the level of confidence placed in the results of the analysis.
Standard deviation (σ):	This is a measure of the variability of individual values in a frequency distribution around the mean value.
Median:	The midpoint of a series of numerical values; it represents a point on a continuum rather than an algebraic average.
Weighted mean:	This is the grand mean of a series of individual means weighted by the total number of observations entering into the computation of the individual means.
Inverse sine transformation:	A transformation frequently applied to percentage values prior to analysis of variance to reduce correlation between means and variances.

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1. ORIGINATING ACTIVITY (Corporate author) US Army Tropic Test Center Fort Clayton, Canal Zone	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

JUNGLE VISION IV: AN EXPLORATORY STUDY ON THE USE OF YELLOW LENSES TO AID PERSONNEL DETECTION IN AN EVERGREEN RAINFOREST.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (Last name, first name, initial)

Dobbins, D. A., M. Gast, and C. M. Kindick

6. REPORT DATE July 1965	7a. TOTAL NO. OF PAGES Twenty-nine (29)	7b. NO. OF REFS Three (3)

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S) Research Report #4
b. PROJECT NO. DA 1L013001A91A	
c. Work Unit: Tropic Test Center #001	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. AVAILABILITY/LIMITATION NOTICES

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY US Army Tropic Test Center Fort Clayton, Canal Zone

13. ABSTRACT The purpose of this study was to explore the use of nonmagnifying yellow yellow lenses to enhance personnel detection in the evergreen rainforest. Twelve US Infantry observers with normal vision, using spectacles fitted with yellow lenses, were each presented 45 randomly appearing human targets within a 180° field of search. The targets, who were dressed in standard Army field clothes, stood motionless at predetermined distance markers facing the observer. Tests were conducted on three sites in the evergreen rainforest of the Canal Zone during the dry season (April 1965). Results were compared with those obtained from 18 additional observers with unaided vision, who were tested on the same sites and under the same conditions.

The major effect of using the yellow lenses was to restrict rather than increase detectability of human targets. Perceptually, the lenses made the targets appear farther from the observers, resulting in significant distance overestimation. Detection times and practice effects were not affected by use of the lenses.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Personnel Detection						
Target Detection						
Visual Threshold						
Tropics						
Human Factors Engineering						
Optical Detection						

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